4.5.8 Starting F.R.D. on PDP-1134, -1144 Systems

To start F.R.D., first halt the processor. Then enter the following commands in response to the ODT prompt:

```
>>>D 177xxxxx 1<CR>                    (Table 4-13)
>>>D 177yyyyy 30003<CR>                (Table 4-14)
>>>D 177yyyyy 42000<CR>
>>>S  200<CR>
```

4.5.9 Starting F.R.D. on PDP-1184, -1124 Systems

To start F.R.D., first halt the processor. Then enter the following commands in response to the ODT prompt:

```
@177xxxxx 1 <LF>                       (Table 4-13)
/177yyyyy 30003 <CR>                   (Table 4-14)
/400 42000 <CR>
/2000
@200G
```

177 xxxxx/000000 1
177 yyyyy/ [illegible] 30003
/000400 42000
177 yyyyy/ [illegible] 2000
200g

When the appropriate starting procedure is completed, F.R.D. identifies itself by displaying the controller type and firmware revision. Then, it displays the menu options. See subsection 5.3 for more information on using Disk F.R.D. or subsection 5.4 for Tape F.R.D.

4.6 Operation

There are no operational instructions. The UC17/18 is ready for initialization as soon as its drives are integrated and tested.

4.6.1 Indicators

There are three light emitting diodes (LEDs) on the UC17/18. These LEDs are used for both diagnostics and for normal operations.

If switch SW1-1 is OFF, the UC17/18 executes a preliminary test at the following times:

- On power-up
- After a reset condition
- After a bus initialization
- After a write operation to the Initialization and Polling (IP) register (base address)

The self-test routine consists of two test sequences: preliminary and self-test. The preliminary test sequence exercises the 80C31 microprocessor chip. When the UC17/18 successfully completes the preliminary test, LED3 illuminates indicating that the UC17/18 is waiting for the MSCP or TMSCP initialization sequence.

During the MSCP initialization sequence, initiated by host software control, the UC17/18 executes a self-test that exercises the buffer adapter functions of the ESP chip, the Host Adapter Chip (HAC) and its associated circuitry, the onboard RAM, and the control memory PROM. If the UC17/18 passes this sequence of its self-test successfully, all the LED indicators on the UC17/18 are OFF.

If a fatal error is detected either during self-test or while the system is running, all three of the LED indicators are ON (illuminated). If the UC17/18 fails to pass its power-up self-tests, you can select a special diagnostic mode (switch SW1-4 or SW4-4 ON) which causes the LED indicators to display an error code. See Self-Test Error Reporting, in Section 6, TROUBLESHOOTING.

During normal operation, LED1 and LED2 flicker occasionally. These LEDs are used to indicate UNIBUS activity.

Section 5
NOVRAM SETUP AND SUBSYSTEM TESTING

This section describes how to set the NOVRAM parameters to configure the UC17/18 Host Adapter for your system. Including this overview, this section is divided into six main subsections:

Subsection	Title
5.1	NOVRAM
5.2	F.R.D.
5.3	Disk F.R.D.
5.4	Tape F.R.D.
5.5	Integration and Operation

5.1 NOVRAM

The UC17/18 utilizes an onboard 512 Byte Non-Volatile Random Access Memory (NOVRAM) to store various pieces of subsystem configuration information needed by the UC17/18 to determine device types, device addresses, device configurations, and to enable or disable various user-programmable options. Diagnostic programs embedded in the firmware of the UC17/18 (Firmware-resident Diagnostics) provide the ability to access the NOVRAM.

5.2 F.R.D.

F.R.D. is an interactive, menu-driven utility program that allows the user to communicate with the UC17/18 via the host CPU console device. Using F.R.D., the user is able to perform various functions, such as loading the NOVRAM with configuration data, formatting and surface-verifying the media on magnetic drives, and initializing RCT areas on both the magnetic and optical media.

In addition to these preparation capabilities, F.R.D. also can be used to perform reliability testing of the subsystem. While not designed to isolate problems to the component level, these reliability tests can aid in isolating a problem to either the SCSI side or the host side of the system.

The UC17/18 actually contains two separate versions of F.R.D.: Disk F.R.D. and Tape F.R.D. Each has a separate set of menus, NOVRAM functions, and command options appropriate to either disk or tape requirements. The F.R.D. program that runs when F.R.D. is started depends on whether the UC17/18 is set for MSCP (Disk) or TMSCP (Tape) emulation.

5.2.1 F.R.D. Conventions

F.R.D. uses the following keyboard conventions:

<CR>	required to terminate operator inputs
<Ctrl C>	aborts the current operation and returns to the main menu

A minimum delay of 10 seconds might occur between the <Ctrl C> and the next display. During some verify operations, the delay might be considerably longer because the abort is delayed until the successful completion of the current command.

In this subsection, operator responses to Disk F.R.D. prompts appear in **bold** print. The symbols used in this subsection are listed below with their meanings:

<CR>	carriage return key
<LF>	line feed key
<Ctrl C>	Ctrl key and the letter C pressed at the same time

5.2.2 Terminating F.R.D.

To terminate F.R.D., choose one of the following:

- Press the BREAK key
- Re-initialize the system, or
- Halt the CPU.

You can restart the diagnostics from a halted condition if you have not changed the memory contents. On a PDP-11 system, enter **S 200** at the ODT prompt. On a VAX system, enter **S 80**.

5.3 Disk F.R.D.

Once started, Disk F.R.D. will display the menu shown in Figure 5-1. The Disk F.R.D. Menu has been specially tailored to offer only those functions appropriate to the preparation and testing of magnetic or optical disk drives.

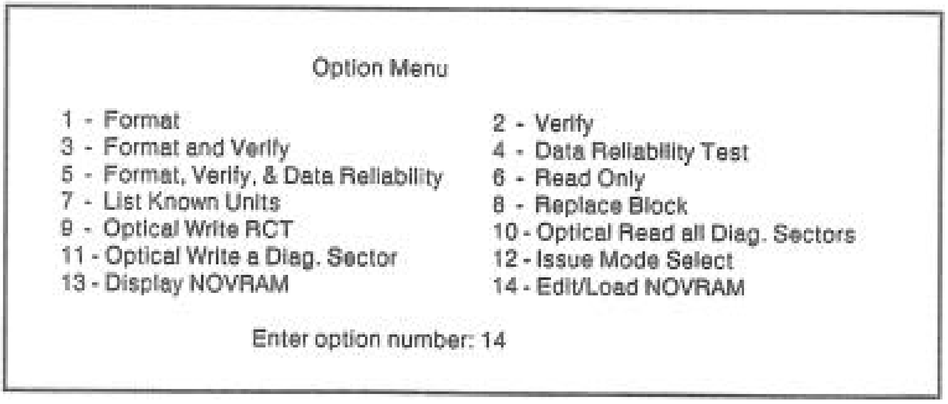
The following sections define each of the available options, their function, and the situations to which they apply. The following sections are presented in the order most commonly used. This might not correspond to the order listed in the menu.

Not all the options listed in the main menu are supported on all device types used with the UC17/18. In these cases, depending on the type of device, Disk F.R.D. returns an "option not supported" message when an unsupported operation is attempted. Unsupported operations are noted in subsequent paragraphs.

The main menu and each submenu will prompt you for required input. When you enter a valid selection, Disk F.R.D. will either perform the selected operation or display the next menu. If you make an invalid entry, Disk F.R.D. rejects it and reprompts you.

Based on the nature of the MSCP emulation being performed, some operations might produce an observable delay when performed on previously unformatted drives. This delay is approximately 30 seconds.

When an option is finished, Disk F.R.D. displays the prompt "Hit any key to continue" and waits for you to do so before returning to the main menu. The menu appears as follows:



```
                          Option Menu

   1 - Format                            2 - Verify
   3 - Format and Verify                 4 - Data Reliability Test
   5 - Format, Verify, & Data Reliability 6 - Read Only
   7 - List Known Units                  8 - Replace Block
   9 - Optical Write RCT                  10 - Optical Read all Diag. Sectors
  11 - Optical Write a Diag. Sector      12 - Issue Mode Select
  13 - Display NOVRAM                    14 - Edit/Load NOVRAM

                     Enter option number: 14
```

Figure 5-1. Disk F.R.D. Main Menu

The option descriptions that follow are ordered according to logical use. If you need to reference an option quickly, check the Table of Contents.

5.3.1 Option 14 - Edit or Load NOVRAM

The UC17/18 Host Adapter uses an onboard NOVRAM to store the subsystem configuration and device geometry information it needs to control the disk drives attached to its SCSI bus.

Before you can begin to use the other Disk F.R.D. options to prepare or test your disk subsystem, your UC17/18 must have the subsystem configuration data loaded in its NOVRAM. This information can be loaded into the NOVRAM using one of the two following methods:

1. **Autoconfigure**

When you select Option 14, you are prompted with a question, "**Do you want to Auto-configure Host Adapter and SCSI bus? [Y or N, def = N]**" If you answer "Y", F.R.D. displays a message asking you to make sure that all attached devices are powered on and ready.

Enter a <Carriage Return>. The UC17/18 then uses SCSI TEST UNIT READY, INQUIRY and other SCSI commands to determine the address and other pertinent information about each attached device.

Information stored in NOVRAM includes drive geometry, SCSI ID, and LUNs for all devices attached to that SCSI ID. Only devices that identify themselves as Random Access Magnetic disk devices cause parameters to be loaded in the NOVRAM. In addition, Autoconfigure displays information about the vendor identification, the product identification, and the revision level information returned by the INQUIRY command of any disk.

Several restrictions must be observed when using Autoconfigure:

- The device must be CCS compatible.
- The device must identify itself as either a Host Adapter (Initiator), Random Access Magnetic Disk, Sequential Access Tape, or WORM (optical) device.
- Autoconfigure cannot resolve SCSI ID conflicts. Before starting Autoconfigure, ensure each SCSI device on the bus has a unique SCSI address. (The UC17/18 will default to SCSI address 7. *If you have more than one UC17/18 on the SCSI bus, you must change the address to avoid conflicts.*)

Failure to observe these restrictions might result in failure of the Autoconfigure feature (No devices shown), or cause the SCSI bus to hang.

After Autoconfigure is finished, the UC17/18 NOVRAM will contain information about SCSI ID, LUNs, and drive geometry as default values. Disk F.R.D. will continue with the rest of the Load/Edit NOVRAM option menu. You will be prompted to load any NOVRAM values not obtainable by Autoconfigure such as DMA Burst Length, MSCP Replacements, etc. When you are prompted for information about autoconfigure-loaded parameters, you can either accept the default value as loaded by Autoconfigure or change it.

Disk F.R.D. prompts you to choose one of four different device type of codes. Once a drive is chosen, the rest of Disk F.R.D. menu will ask questions appropriate to that device type.

If you specify a type code other than 4 (Autosize), F.R.D. asks if you want to alter device geometry. If the answer is "N", you will not be prompted for information about device geometry. If you answer "Y", each question about drive geometry will be prefaced by a comment that indicates the drive geometry might not be changeable; in these cases, the device default will be used.

If you choose type code 4 (Autosize), you will not be prompted for any information concerning device geometry. The UC17/18 will obtain that information from the device each time the device is brought online. This allows the user to freely exchange drives of different sizes without changing the NOVRAM.

2. Manual

When you select Option 14, you are prompted with the question, "**Do you want to Auto-configure the SCSI bus**"? If you answer "N", you are then prompted for NOVRAM information. You must know the SCSI ID and LUN information for each device you intend to configure. In addition, unless you choose type code 4, you will be asked to supply device geometry information for each device you configure.

If you specify a type code other than 4 (Autosize), F.R.D. asks if you want to alter device geometry. If the answer is "N", you will not be prompted for information about device geometry. If you answer "Y", each question about drive geometry will be prefaced by a comment that indicates the drive geometry might not be changeable; in these cases, the device default will be used.

NOTE

> The default value, which appears with the range of values for each option, is indeterminate and indicates **only** the current value. This value might or might not be the value that your installation requires.

5.3.1.1 DMA Threshold

This parameter sets the DMA threshold value. The UC17/18 uses this value to determine how many words into a DMA burst it will wait before checking to see if another device on the UNIBUS has set NPR. The valid range is from 1 through 8. The higher you set this value, the less often the UC17/18 will relinquish bus mastership to other devices. In systems with a large number of interactive terminal users, the frequency of UNIBUS bus interrupts can be quite high. In this type of application, if you set the DMA threshold too low, the effect is to increase the length of time it takes for disk applications to complete. If you set the DMA threshold too high, it might affect the apparent user terminal response time. Emulex recommends setting this value to eight, then decreasing it only if terminal response or data late problems on other devices occur.

5.3.1.2 DMA Burst Delay

This parameter sets the value of time in microseconds that the UC17/18 waits to raise NPR between DMA bursts. The valid range is 2 through 32, in multiples of 2. The suggested value is 2.

Emulex recommends using a minimum value of 2.

Keep in mind that the lower you set this value, the less opportunity other devices will have to get their DMA requests honored. This is particularly true if the UC17/18 is on the front of the bus. If you have a lightly-loaded system with a limited number of users and disk speed is the important consideration, set this value to the minimums defined above. If you add interactive users and devices to the system, you might need to increase the value of this parameter to maintain a balance among disk throughput, terminal response, and DMA needs of other devices on the bus.

5.3.1.3 Host Adapter SCSI Address

This parameter sets the SCSI address of the UC17/18. The valid range is from 0 through 7, and the suggested value is 7. *If you have more than one UC17/18 connected to the same SCSI bus, you must change this value to avoid conflicts.*

5.3.1.4 Enable SCSI Parity Checking

This parameter enables or disables SCSI parity checking. A "Y" response enables parity checking, while a "N" response disables parity checking. Before enabling this option, ensure that the SCSI device you are connecting supports parity.

5.3.1.5 Enable ESP Chip Slow Cable Mode

This parameter enables or disables the ESP IC's slow cable feature. A "Y" response enables the Slow Cable mode, while a "N" response disables the mode.

This feature might need to be enabled in systems where unshielded cables of maximum SCSI bus length are used in noisy environments. The Emulex SCSI Processor (ESP) IC used on the UC17/18 is a very high speed device. Because of this speed, it is possible for the IC to react to a short duration noise pulse, which might be ignored by slower or lower performance SCSI chips. When the Slow Cable mode is enabled, the ESP chip requires longer signal durations on these critical signals, thereby acting as a noise filter. Emulex recommends using shielded SCSI cables and minimizing cable lengths, to eliminate the need for Slow Cable mode.

If you must use unshielded maximum length cables, Emulex recommends that you enable Slow Cable mode. Except in the case of very high speed synchronous disk drives, this use of Slow Cable mode will have no adverse effect on system performance.

5.3.1.6 Unit Offset or Autoboot Unit Number

The **Unit Offset or Autoboot Unit Number** parameter functions differently, depending on whether the UC17/18 is at the standard base address, or at an alternate base address. The valid range for this parameter is from 0 through 15.

The following two subsections (Autoboot Unit Number and Unit Offset) respectively describe the operation of the UC17/18 at the standard base address, and at an alternate base address.

5.3.1.6.1 Autoboot Unit Number

When the UC17/18 is at the standard base address, the automatic bootstrapping option causes the system to boot automatically from the selected logical unit (0 through 7) on power-up. This option is enabled whenever the UC17/18 is set to the standard base address. When automatic bootstrapping is enabled, the **Unit Offset or Autoboot Unit Number** parameter selects the autoboot logical unit.

If you are using automatic bootstrapping, the controller will wait indefinitely for the boot device to come online and ready.

If your UC17/18 is installed at an alternate UNIBUS bus address, you can still bootstrap from a drive supported by the UC17/18, by using any boot process other than autoboot.

5.3.1.6.2 Unit Offset

If the UC17/18 is installed as a second MSCP controller at an alternate address, the **Unit Offset or Autoboot Unit Number** parameter has a different function. Some operating systems require that no two MSCP drives have the same MSCP Unit number, even though the units may be attached to different controllers at different CSR addresses.

This parameter allows you to specify the MSCP Unit number of the first drive on the UC17/18 when your UC17/18 is being installed as a second MSCP controller (at an alternate UNIBUS bus address). You can either specify a unit number that is contiguous with the highest unit number on the MSCP controller at the primary UNIBUS bus address, or you can leave a gap.

5.3.1.7 Type Code

Each SCSI target device attached to the host adapter's SCSI bus must be defined in the NOVRAM by a type code. A maximum of 7 SCSI target devices can be attached to each SCSI bus. SCSI initiator devices on the bus are not identified in the NOVRAM, however the total number of SCSI devices including targets and initiators cannot exceed 8. The UC17/18 recognizes four different type codes (type code 1 through type code 4) for SCSI target devices.

For each SCSI target device that you define, Disk F.R.D. will prompt you for the remaining configuration parameters. The type code you specify for each target device determines which configuration parameters are required. The type codes are as follows:

TYPE CODE 1 (ST506 Device)

A type code of 1 indicates that the SCSI target device being configured is a SCSI/ST506 device (for example, an Emulex MD01).

TYPE CODE 2 (ESDI Device)

A type code of 2 indicates that the SCSI target device being configured is a SCSI/ESDI device (for example, an Emulex MD21, MD23, or MD25, or a disk drive with an embedded SCSI controller).

TYPE CODE 3 (Optical Device)

A type code of 3 indicates that the SCSI target device being configured is a WORM (Write Once Read Many) optical drive or a Magneto optical drive.

TYPE CODE 4 (Autosize Device)

A type code of 4 indicates that the SCSI target device being configured is any one of the three previous types, and that the physical configuration is to be defined by data received from the target device. The purpose of type code 4 is to allow the target device parameters to change, without having to reconfigure the device parameters in the NOVRAM each time a new device is attached. This feature is particularly useful in systems using a removable Winchester drive, such as the Emulex ER2/S.

In order to use type code 4, the target device must support the following SCSI commands:

- INQUIRY (12H)
- MODE SENSE (1AH)
- READ CAPACITY (25H)

CAUTION

If type code 4 is used to autosize optical disks, disk packs written with the Emulex UC04 Host Adapter will NOT be format-compatible with the UC17/18. See Appendix C for UC04 compatibility data.

A number of factors must be taken into account when using type code 4. The values returned and the source of these values varies from device to device and vendor to vendor. Because of the wide variety of device types and device vendors' products that can be attached to the UC17/18, it is beyond the scope of this manual to identify the method used by a specific vendor or device type. In general, the following methods are widely used today:

1. Physical geometry, option configuration, and other device-dependent information is written on the device media at format time. The actual values used might come from default parameters supplied by the device controller itself, or from values supplied by the host adapter that was attached to the device at the time that the device was formatted.
2. Physical geometry, option configuration, and other device-dependent information is supplied by the device controller based on jumper and switch settings on the device controller or coded in the device controller's firmware.

Because of these inconsistencies, the UC17/UC18 uses the following methods to define drive size when type code 4 is selected.

Format Operation

When the UC17/UC18 performs a format operation, it will first perform a mode sense to obtain default values. The information returned will be used to issue a mode select followed by a format command. This means that any parameter saved on the disk will be destroyed, and the drive will be formatted to its default size.

Normal Operation

Except when formatting, the UC17/UC18 uses a MODE SENSE REQUEST CURRENT VALUES to size the drive.

Note

If you use the list option to display the drive size on a previously unformatted or non-UC17/UC18 formatted drive, the drive size and the contents of the NOVRAM will be incorrect.

5.3.1.8 Block Size

This parameter specifies the size of a logical block, in bytes, on the optical drive. The acceptable values are 0 for a block size of 512 bytes, or 1 for a block size of 1024 bytes. Disk F.R.D. will request this parameter only for type code 3.

5.3.1.9 Number of Blocks per Track

This parameter specifies the number of blocks per track. The valid range is from 1 through 255. Disk F.R.D. will request this parameter only for type code 3.

5.3.1.10 Size of Drive in Blocks

This parameter specifies the size of the optical drive in blocks. The valid range is from 200 through 4,294,967,295. Disk F.R.D. will request this parameter only for type code 3.

5.3.1.11 Total Number of Physical Sectors per Track

This parameter specifies the total number of physical sectors per track, including spares. The valid range is from 1 through 255. Disk F.R.D. will request this parameter only for type codes 1 and 2.

5.3.1.12 Total Number of Physical Heads

This parameter specifies the total number of physical data heads per physical drive. The valid range is from 1 through 63. Disk F.R.D. will request this parameter only for type codes 1 and 2.

5.3.1.13 Total Number of Physical Cylinders

This parameter specifies the total number of physical cylinders per physical drive, including spares. The valid range is from 1 through 4095. Disk F.R.D. will request this parameter only for type codes 1 and 2.

5.3.1.14 Number of Spare Sectors per Track

This parameter specifies the number of spare sectors to reserve per track. The valid range is 0 through 3. If 0 is specified, no spare sectors are reserved. Disk F.R.D. will request this parameter only for type codes 1, 2, and 4. The suggested value is 1.

5.3.1.15 Number of Alternate/Spare Cylinders

This parameter specifies the number of spare cylinders per physical drive. The valid range is from 2 through 250. At least two cylinders must be specified as alternates, as the sector replacement algorithm needs tracks for working space. The suggested minimum value is 2.

Disk F.R.D. will request this parameter only for type codes 1, 2, and 4. If there are no spare sectors, Disk F.R.D. will not request this parameter.

5.3.1.16 Enable MSCP Replacements

This parameter enables or disables MSCP replacements. A "Y" response enables MSCP replacements, while a "N" response disables MSCP replacements. Disk F.R.D. will request this parameter only for type codes 1, 2, and 4. For details about the effect of this option and device requirements, see subsection 5.3.1.28.

5.3.1.17 Enable Transparent Replacements

Disk F.R.D. will request this parameter only if the answer to the previous question (enable MSCP replacements) was "N", and only if the type code is 1, 2, or 4. This parameter can also be enabled for type code 3 with Magneto-Optical drives. This parameter enables or disables transparent replacements. A "Y" response enables transparent replacements, while a "N" response disables transparent replacements. For details about the effect of this option, see subsection 5.3.1.28.

5.3.1.18 Ignore FCT (Factory Caching Table) Errors

Disk F.R.D. will request this parameter only if transparent replacements are enabled, and only if the type code is 1, 2, or 4. This parameter can also be enabled for type code 3 with Magneto-Optical drives. A "Y" response to this parameter causes Disk F.R.D. to ignore FCT errors.

This parameter should be set to "Y" only in case of a malfunction which has caused the FCT area to become corrupt. If this happens, the UC17/18 will not bring the device online, thus making it impossible to access the data on the device. Setting this parameter to "Y" allows the online function to ignore FCT errors and allows the device to be brought online to retrieve the data. Once the data has been retrieved, this parameter should reset to "N" and the device should reformat.

5.3.1.19 Split Drive

This parameter allows the drive defined by this parameter block to be split into two logical disk units. Disk F.R.D. will request this parameter only for type codes 1 and 2. A "Y" response splits the drive.

A format command to the first logical unit will reformat the entire drive (BOTH logical units).

5.3.1.20 Starting Block Number for Second Logical Drive

This parameter will be requested only if the answer to the previous question (split drive) was "Y". This parameter specifies the starting block number of the second logical drive. If the starting block number entered does not fall on a track boundary, Disk F.R.D. will truncate the value to the next lower track boundary. The valid range is any value between 10 cylinders from the beginning of the drive and 10 cylinders from the end of the drive.

5.3.1.21 Reduced Write Current Cylinder

Disk F.R.D. will request this parameter only for type code 1. This parameter specifies the physical cylinder at which the write current to the data heads is reduced. Some drives require that the write current to the heads be reduced above a certain cylinder to reduce the strength of the flux transition. This reduction prevents adjacent flux transitions in the higher cylinders (where they are closer together) from displacing one another to such an extent as to force data bits out of their data clock windows.

The valid range is from 0 through 4095. If you do not require a current reduction, specify the total number of physical cylinders.

5.3.1.22 Write Precompensation Cylinder

Disk F.R.D. will request this parameter only for type code 1. This parameter specifies the physical cylinder at which the timing of write data transmitted to the disk drive must be advanced or retarded (with reference to the disk data clock). This timing shift compensates for timing shifts that are caused by adjacent flux transitions in the higher cylinders (where they are closer together). Shifting the write data with respect to the data clock ensures that, when the data is read back, the data will fall within the clock window, despite the tendency of one transition to affect the apparent position of the adjacent transition. This shifting is called precompensation.

The valid range is from 0 through 4095. If write precompensation is not required, specify the total number of physical cylinders.

5.3.1.23 Step Rate/Code

Disk F.R.D. will request this parameter only for type code 1. This parameter specifies the stepping mode or step pulse rate of the disk drive. The valid range is from 0 through 65,535. The table below is an example based on the Emulex MD01. For other devices, consult the user manual supplied with the device.

Step Code	Stepping Mode
0	Unbuffered, 3 msec
1	Buffered, 11 usec
2	Buffered, 12 usec

For the MD01, Emulex recommends the fastest buffered step code available (step code of 1). Use a slower buffered step code or the unbuffered step code if your drive requires it.

5.3.1.24 Removable Media

This parameter indicates whether the disk media is fixed or removable. A "Y" response indicates that the media is removable; a "N" response indicates fixed media.

5.3.1.25 Disable SCSI Disconnects

This parameter disables or enables SCSI disconnects. When enabled, drives performing time-consuming tasks release the SCSI bus temporarily and reconnect when the task is complete; thus, several operations can be performed at once. Timing considerations for unique software applications might dictate that you disable disconnects.

A "Y" response disables SCSI disconnects, while a "N" response enables SCSI disconnects.

5.3.1.26 Prevent Manual Spindown

This parameter allows the user to prevent inadvertant spindown of a mounted media. This parameter is particularly important when a WORM optical drive is used because failure to write cached data and device maps to a disk before it is spun down can result in data loss.

A yes response causes the UC17/18 to issue a SCSI Prevent/Allow Media Removal command with the Prevent bit set whenever a device is brought online. This command prevents manual spindown of the drive until a Dismount command is issued by the operating system. When the operating system issues a Dismount command, the UC17/18 issues a SCSI Prevent/Allow Media Removal command with the Prevent bit reset to unlock the drive and allow manual spindown of the drive.

A no response disables the UC17/18 from sending the SCSI Prevent/Allow Media Removal command during Mount and Dismount operations. No is the default setting. Regardless of how this parameter is set, the UC17/18 will issue a SCSI Stop command to the device when a Dismount/Unload command is issued by the operating system.

5.3.1.27 Enable Synchronous Data Transfers

This parameter enables or disables synchronous SCSI data transfers. A "Y" response enables synchronous data transfers; a "N" response disables synchronous data transfers. Before enabling this option, be sure that the target device being configured supports synchronous SCSI data transfers.

5.3.1.28 Disable Host Adapter of Polling Drives

During normal operation, the UC17/18 will periodically issue Test Unit Ready commands to determine changes in Power On status of devices on the SCSI bus. This action resets the Attention condition issued by SCSI devices on the first access after a power on. In some cases, where the user has written a SCSI driver that interfaces directly with the device via SCSI commands, for example, Pass Thru SCSI Mode, polling must be disabled to allow the driver to detect and reset this attention condition. A yes response disables polling.

A no response enables normal device polling. When the UC17/18 is used in systems which use a standard MSCP driver this parameter must be enabled (user response = n) to allow proper operating system response to drive Powerup/Powerdown transitions.

5.3.1.29 Defining Addresses for Physical Drives

A SCSI address and SCSI LUN must be defined for every drive in the system. Two values are written for each physical drive: the first value is the SCSI address of the controller and the second value is the drive's SCSI LUN. The value that you select in NOVRAM for each controller's SCSI address must match the corresponding SCSI address selected on the controller. Similarly, the value that you select in NOVRAM for each drive's LUN must match the corresponding LUN value selected on the drive. In addition, no two SCSI devices on any one SCSI bus can have the same SCSI address.

The SCSI controller address range is 0 through 7; the SCSI LUN range is 0 through 7. For each physical unit that you configure, you will be prompted to specify a value for both the SCSI controller address and for the drive LUN.

After you have answered all the configuration questions, F.R.D. will prompt for another unit. If no units remain to be configured, or you have reached the limit of 8 logical unit numbers, F.R.D. will ask if you want to change any parameters before loading the NOVRAM.

```
Do you want to configure another unit [Y or N, def=N]?

Do you want to change any parameters [Y or N, def=N]?

 ** ALL DATA ON DRIVE CAN BE LOST **
DO YOU WANT TO LOAD THE NOVRAM [Y or N]?
```

5.3.1.30 Defect Management

The UC17/18 offers the user a choice of three methods to manage defects on magnetic disks. The type of defect management used must be programmed in the NOVRAM for each SCSI target device. The type of defect management scheme you choose depends on your application and the capabilities of the SCSI target device performing the defect management.

5.3.1.30.1 Host-Initiated Bad Block Replacement

Sometimes referred to as MSCP-compatible mode, Host-Initiated Bad Block Replacement is a scheme whereby the host software is responsible for issuing MSCP "replace" commands to initiate block replacement. The conditions under which the host software issues a replace command are dependent upon the host software and the type of error information generated by the UC17/18.

This mode of operation is fully DEC compatible and provides software control of replacements. It even allows blocks with uncorrectable or otherwise inaccessible data to be replaced by using a forced error flagging scheme to mark the replaced block in a way that informs the operating system that only the data in the block is bad; the block itself is good.

This method also provides power fail protection for those cases where a power fail occurs in the middle of a replacement operation. Various flags are used to indicate what step of the replacement is in progress at all times, so that when power is re-applied, any replacement in process can begin where it left off. Emulex recommends using this mode whenever possible.

To use MSCP replacement, the target device absolutely must support all four of the following:

- A 48-bit ECC guarantees that any 16-bit data error will be reported as an uncorrectable ECC error.
- SCSI Re-assign, Read Long, and Write Long commands
- The SCSI target device must guarantee that the ECC provided by the UC17/18 during the Write Long operation is not modified in any way by the target device before being written to disk.
- The SCSI target device must guarantee that the ECC written to the disk during the Write Long operation is not modified in any way by any subsequent Read or Read Long operation.

The only SCSI devices that Emulex guarantees will support Host-Initiated Bad Block Replacement are the Emulex MD01, MD21, MD23, and MD25 controllers, and the Emulex ER2/S removable subsystem.

While some SCSI device controllers and embedded drives might support these features, Emulex cannot guarantee proper operation now or in the future.

It is the user's responsibility to contact the vendor of the SCSI device to secure compliance and performance commitments.

This mode is enabled by answering "Y" to the NOVRAM prompt, "Do you want to enable MSCP replacements?"

5.3.1.30.2 Controller-Initiated Bad Block Replacement

Sometimes referred to as Transparent mode, Controller-Initiated Bad Block Replacement is supplied as a best-case alternative to Host-Initiated Bad Block

Replacement for those SCSI target devices that do not provide the features required for host-initiated replacement. In this mode, the UC17/18 firmware initiates and controls the replacement operations transparently to the host software. This mode allows blocks with correctable data errors to be replaced via the SCSI re-assign command. The replacement operation is protected during power fails by caching the data and using flags that indicate the progress that has been made on any replace command that was in progress when the power fail occurred. During the replacement operation, a special FCT area on the disk is used to cache replacement data and progress flags.

The principle disadvantage of this method is that since forced error flagging cannot be done, blocks with uncorrectable data errors or inaccessible data fields cannot be replaced dynamically during system operation. In the case of uncorrectable data errors (for example, uncorrectable ECC error, block not found, etc.) the UC17/18 simply reports the fact that an uncorrectable error has occurred. The operating system will then proceed to deal with the error much as it would deal with a "Forced Error". Blocks with uncorrectable data errors can only be replaced by using the replace block operation of Disk F.R.D.

Blocks with correctable or soft data errors are replaced dynamically by the controller before they become uncorrectable. For these replacements to occur, the SCSI target device must support the SCSI re-assign commands and must report the fact that a correctable error has occurred. Correctable errors can include ECC-correctable data errors or retry-corrected header operations. If the target device simply sends corrected data or retries the operation until it is successful, but does not report the error to the UC17/18, no replacements will occur.

Correctable errors will be reported to the operating system via the MSCP error log packets, to enable the operating system to be aware that replacements have in fact taken place. This allows the user to monitor the status of a particular drive.

This mode is enabled by answering "N" to the NOVRAM prompt, **"Do you want to enable MSCP replacements?"** and "Y" to the NOVRAM prompt, **"Do you want to enable transparent replacements?"**

5.3.1.30.3 Non-Block-Replaceable Device Mode

The Non-Block-Replaceable Device mode must be used if the SCSI target device does not support the SCSI re-assign command, or if the target device is an optical device. This mode completely precludes dynamic block replacement of any kind while operating the system.

All errors, correctable or uncorrectable, will be reported to the system via MSCP errlog messages. This mode of operation should only be used with devices that provide very sophisticated error recovery schemes that preclude the occurrence of reported errors (for example, optical devices).

This mode is enabled by answering "N" to the NOVRAM prompt, **"Do you want to enable MSCP replacements?"** and "N" to the NOVRAM prompt, **"Do you want to enable transparent replacements?"**

NOTE

All of the following options are designed to be run on multiple drives. Prior to starting each option you will be prompted for a device number to test. Device numbers can be entered in any sequence. To terminate the drive number prompt, enter a <CR>. All operations except Reliability are performed on a single drive at a time. Any drive that fails is dropped and testing moves to the next drive in the string. The Reliability tests are run on all specified devices simultaneously.

5.3.2 Option 1 - Format

The Format option initially formats a magnetic disk drive. The operation writes sector headers and initializes the drive's RCT tables. It is used to format a virgin drive, a drive that has been determined to contain unusable data, or a drive with a format that is improper to use with a particular controller.

After formatting, the drive contains a valid RCT (Replacement Caching Table) with a serial number you specified.

The SCSI Device Controller performs the actual format operation in response to a SCSI format command with the "Complete List" and "Format Data" bits set. The Defect List sent will indicate no defects.

Depending on the SCSI device controller used, the format operation might also replace defective blocks contained in the Manufacturer's Defect List (MDL), perform a Read after Write pass with worst case data patterns and replace any blocks with errors, or any other tests to find and replace defective blocks. The following subsections are a list of actions performed by Emulex SCSI bridge controllers during formatting.

CAUTION

When Option 1 (Format) is used, BOTH logical units on a split drive WILL BE FORMATTED. When formatting a split drive, YOU MUST SPECIFY BOTH UNITS WHEN ASKED FOR DEVICE NUMBERS TO TEST.

5.3.2.1 Emulex MD01 (SCSI/ST506)

When the format command is received, the MD01 will format the entire unit using the geometry information sent from the UC17/18 via the Mode Select Command. After the format completes, each block on the drive is read. Any block that produces an error during the read operation is replaced.

5.3.2.2 Emulex MD21, MD23, and MD25 (SCSI/ESDI)

When the format command is received, the MD21, MD23 and MD25 will format the entire unit using the geometry information sent from the UC17/18 via the mode select command. Any blocks listed in the drive's MDL will be replaced during the format operation. Blocks listed in the Grown Defect List (GDL) are not replaced during format. This is done purposefully to prevent blocks which may have been erroneously replaced in the event of a system malfunction. Because the MD21, MD23 and MD25 controllers replace all blocks listed in the MDL, they do not use the read pass performed by the MD01 controller.

When the mode select command containing the drive geometry information is received, the MD21, MD23 or MD25 checks the value supplied for the number of sectors per track. If the drive being formatted is in hard sector mode and there is a difference between the value requested and value returned by the drive, the Mode Select Command will be rejected by the MD21, MD23 or MD25. Disk F.R.D. will print a warning message:

```
MODE SELECT COMMAND FAILED FORMATTING WITH DRIVE DEFAULT PARAMETERS
```

The format will continue to normal completion. The consequence of this message is that the value returned for user size might not be accurate. This can be corrected either by reloading the NOVRAM with the correct value for the number of sectors per track, or by setting the NOVRAM to autoconfigure the device.

5.3.2.3 Non-Emulex SCSI Devices

In general, most SCSI devices on the market today support the Mode Select Command and will follow the same rules that Emulex controllers follow. Keep in mind that the Mode Select is an optional SCSI command. Some devices do not support the Mode Select Command because their geometry is fixed by switch settings, by jumper settings, or by firmware. In this case, the Mode Select Command will fail and Disk F.R.D. will print a warning message. Operation will continue as described for the MD21, MD23 and MD25 controllers. The only way to guarantee that a valid user size is presented to the system is either by setting the NOVRAM to autoconfigure the device, or by ensuring that the geometry values loaded into the NOVRAM match the actual drive geometry.

5.3.2.4 Magneto-Optical Devices

Although Magneto-Optical devices appear to the system as re-writable devices, they contain peculiarities that must be taken into account during format. When the Sony drive is issued a format, the drive actually formats the disk pack. The Richo drive performs a dummy format, which does not format the drive at all. In addition, the Richo drive reacts like a WORM device: when it reads an unwritten block, it returns a Blank Check condition. Since this is unacceptable on a magnetic device, a block must be written before it can be read.

The UC17/18 stabilizes these peculiarities by performing a Single Pattern Write Pass of the entire disk pack whenever the Format option is invoked. This feature allows you to read all blocks on the disk after format, just like a magnetic drive.

5.3.3 Option 2 - Verify

The Verify option write- and read-exercises all user-available blocks. Disk F.R.D. uses four worst-case data patterns to find and replace pattern-sensitive blocks not found in the drive defect list. It asks for the logical unit number (LUN) of the drive to be verified. After you have entered all the LUNs to be verified, Disk F.R.D. will prompt for the number of Write/Read passes.

Verify operations are performed on 32 logical blocks at a time. Logical blocks are referenced by Logical Block Numbers (LBN).

During verify operations, Disk F.R.D. does not do anything to cause the SCSI target device to diminish its normal error recovery techniques. This means that the ability of Disk F.R.D. to find and replace defective areas on the media depends on the target device reporting that an error condition has occurred. Generally, the lower the level of filtering that the device does, the more efficient the Verify option will be.

When Disk F.R.D. encounters a block that it cannot access because of header or data field errors, Disk F.R.D. displays the LBN in error. Because the failing pattern might not be the first pattern, it is possible that replacement blocks might not be tested with all patterns. For this reason, Emulex recommends running at least two Verify passes over all 4 data patterns.

The verify option also offers a bad block replacement feature which, when enabled, replaces any bad blocks reported by the SCSI target device.

At the end of all testing or when you enter a <Ctrl C>, Disk F.R.D. reports the number of bad blocks detected by the Verify operation. There will be no message if the Verify option does not detect any errors.

5.3.4 Option 3 - Format and Verify

The Format and Verify option formats a drive, then tests the surface for defective and pattern-sensitive sectors. It performs both of the operations that are available separately with options 2 (Format) and 3 (Verify). This option also offers a bad block replacement feature which, when enabled, replaces any bad blocks found during the verify operation.

5.3.5 Option 4 - Data Reliability Test

The Data Reliability Test option thoroughly tests the disk subsystem. The reliability test uses Write, Write/Check, and Read functions to test the controller-to-drive portion of the subsystem. In addition, an independent DMA operation between the host memory and the controller tests the host-to-controller interface.

The test defaults to two reserved diagnostic cylinders so that user data will be protected. However, at your option the Data Reliability Test can check the entire disk, including the user data area. To run the reliability test indefinitely, select 0 (zero) passes.

If the test encounters errors, Disk F.R.D. displays text error messages. These messages are primarily for use by Emulex technical support personnel.

5.3.6 Option 5 - Format, Verify, and Reliability Test

The Format, Verify, and Reliability Test option combines Options 2 (Format), 3 (Verify), and 5 (Data Reliability Test). This option automates the initialization and testing of drives, since you can select multiple drives and activate the data reliability test without having to wait for the format and verify options to complete. The format and verify portions of this option run in the order of the drives selected. Drives with hard faults are dropped and the sequence moves to the next drive in the list. The reliability portion of this option runs simultaneously on all selected drives.

5.3.7 Option 6 - Read-Only Test

The Read-Only Test option causes all the user-available blocks on the selected drive to be Read-only, not Read/Write, during the Verify pass. When a block is encountered that cannot be accessed because of header or data field errors, Disk F.R.D. displays the Logical Block Number.

The Read-Only Test option also offers a bad block replacement feature that, when enabled, replaces any bad blocks. Because Disk F.R.D. does not cache any read data, no corrected data is available to put in the replacement block. This means that the defective block is replaced, but no forced error flag is set in the replacement sector, so the data is nonvalid.

CAUTION

This might cause problems if the replaced blocks contain executable program files. For this reason, you should back up sensitive data before running the Read-Only Test option with the replacement feature enabled.

The Read-Only Test option can be used only if the drive is formatted.

5.3.8 Option 7 - List Known Units

The List Known Units option lists all the drives that are configured in the NOVRAM. Only those units that the controller can select are listed as available.

A user size (512-byte blocks) is listed with all drives found by this option. The user size does not include RCT area, diagnostic cylinders, designated or hidden spare tracks or blocks, etc.

NOTE

> When creating partitions under ULTRIX, be sure a partition does not extend past the user area into the RCT or diagnostic area. Like all MSCP devices, the UC17/UC18 depends on the host software to control accesses to the RCT and diagnostic area of the disk. Failure to observe the user size limitation might corrupt the disk and render it unusable without reformatting.

The user size reported by this option is calculated from geometry data contained in the NOVRAM for either type code 1 or type code 2. When type code 4 is used to autoconfigure devices, the user size is calculated from geometry information returned by the Mode Sense command.

In order for the reported user size to be accurate, the following two conditions must be met:

- When using SCSI target devices that support Mode Select and Mode Sense, a Mode Select Failure message must not have occurred during format of the device. If such a message was received, the user size reported by this option will be incorrect, because the geometry information contained in the NOVRAM does not agree with the geometry parameter used by the device during formatting. If this occurs, you can correct the user size by reloading the NOVRAM with the correct geometry information and reformatting the drive.
- When using SCSI target devices that do not support Mode Select and Mode Sense, you must ensure that the drive geometry values loaded into the NOVRAM are identical to those used by the target device.

5.3.9 Option 8 - Replace Block

The Replace Block option allows you to replace a specific bad block or group of bad blocks without using the blanket replacement feature found in the Verify and Read Only options. You enter the logical blocks to be replaced in decimal MSCP Logical Block Number format.

5.3.10 Option 11 - Optical Write a Diagnostic Sector

The Optical Write a Diagnostic Sector option verifies the ability of the optical subsystem to correctly perform write operations in a special diagnostic area before attempting to write data in the RCT or data area. Each time this option is invoked, the UC17/18 writes the next blank section available from the diagnostic area. The data field is written with the LBN of the sector being written. After the write occurs, a read check is performed to verify proper write operation.

Note that this option is not to be used on Magneto-Opticals.

5.3.11 Option 10 - Optical Read All Diagnostic Sectors

The Optical Read All Diagnostic Sectors option performs a read operation on all diagnostic sectors previously written. Proper read operation is verified by comparing the LBN information read from the data field with the LBN being accessed and verifying that they match.

Note that this option is not to be used on Magneto-Opticals.

5.3.12 Option 9 - Write RCT

Option 9 is used to initialize the RCT area on a disk drive as required by MSCP. This option is designed primarily for use on optical (WORM) drives that cannot use the FORMAT option. Also, use this option to initialize the RCT area on a magnetic or Magneto-Optical drive that has previously been formatted by a non-Emulex host adapter.

This option will prompt for a serial number. Enter the number into the RCT area. Before writing the RCT, this option first checks to see if the device is a WORM. If so, it will check to see if the chosen RCT already exists. If it does, F.R.D. will inform the user that the RCT is invalid and no write will be performed. If the RCT Write is successful, F.R.D. performs a READ pass to verify that the RCT was properly written. If the attached drive is a WORM, this option should only be used after verifying proper subsystem operation using Option 10 (Optical Read All Diagnostic Sectors) and Option 11 (Optical Write a Diagnostic Sector).

The UC17/18 does not require an RCT on Optical WORM disk packs. This option has been provided to create packs that must be used on Emulex UC04/14 or UC07/08 host adapters with Revision "F" or lower firmware.

5.3.13 Option 12 - Issue Mode Select

This option enables a user to issue a MODE SELECT command to a device that is configured in NOVRAM. Data can be altered (if CSS compatible) one byte at a time. Consult the drive manufacturers' documentation to find the appropriate SCSI parameter values to issue to the drive. The SCSI commands that must be supported are MODE SENSE and MODE SELECT. Note that issuing Mode Select is of no use if the device does not save the parameters.

5.3.14 Option 13 - Display NOVRAM

This option displays the current contents of the NOVRAM.

5.4 Tape F.R.D.

Tape F.R.D. is a diagnostic utility designed to provide the following functions:

- Load and Edit the configuration data needed by the UC17/18
- Test the functions of the host adapter and tape drive
- Verify the switch settings on the UC17/18 module

Options are selected through menus, which are accessed from the host system console.

NOTE

> Configuration options must be loaded into the NOVRAM before the host adapter can be used. Although the NOVRAM is loaded at the factory, its contents might not meet your system requirements.

After you specify the type of terminal and enter a <return>, Tape F.R.D. displays the Tape F.R.D. Main Menu.

5.4.1 Initial Screen

The initial Tape F.R.D. screen shows the revision level of the Tape F.R.D. firmware being used, the tape drive(s) status, and the CSR address location. Tape F.R.D. prompts you to specify whether you are using a video or hardcopy terminal to run the diagnostics.

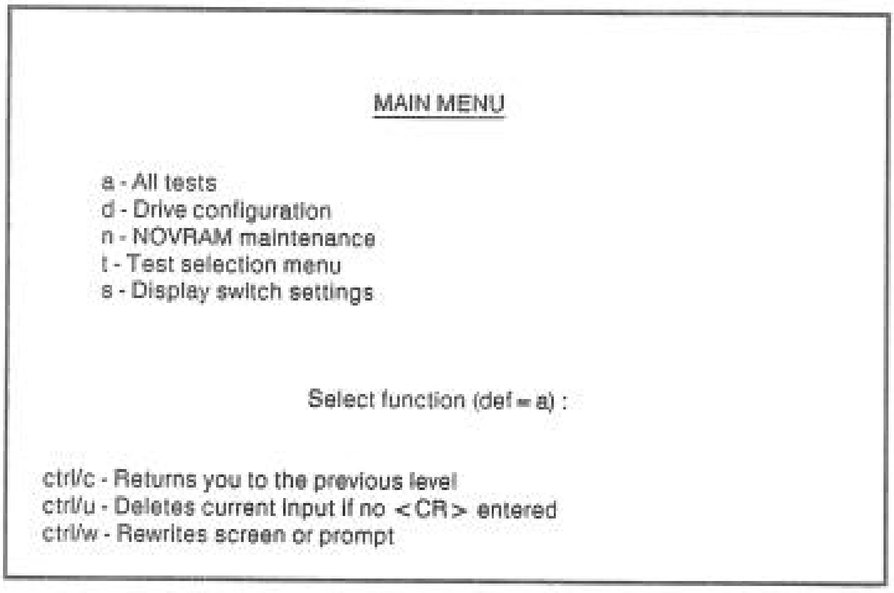
NOTE

> Video Display mode supports only DEC VT100 series video terminals and compatible video terminals. Use Hardcopy mode for all other terminals.

After you specify the type of terminal and enter a <return>, Tape F.R.D. displays the Tape F.R.D. Main Menu.

5.4.2 Tape F.R.D. Main Menu

Figure 5-2 shows the Tape F.R.D. Main Menu as it appears on a video display terminal. This menu presents choices for running tape diagnostic tests, configuring the subsystem for tape drive characteristics, and for displaying the switch settings.



```
                              MAIN MENU

   a - All tests
   d - Drive configuration
   n - NOVRAM maintenance
   t - Test selection menu
   s - Display switch settings


                         Select function (def = a) :


ctrl/c - Returns you to the previous level
ctrl/u - Deletes current input if no <CR> entered
ctrl/w - Rewrites screen or prompt
```

Figure 5-2. Tape F.R.D. Main Menu

NOTE

On initial power up, some drives (i.e., Exabyte) might be unaccessible on the SCSI bus for up to 120 seconds while running self tests. Because of this, the drive status that Tape F.R.D. returns can vary, depending on the state of the drive when Tape F.R.D. was started. The drive status can be any of the following:

- Unit not there
- Unit offline or not ready
- Unit online

To make a selection from the Main Menu, type the letter of the selection you want and follow it with a <return>. The choices are:

A - All tests. All onboard firmware installation diagnostic tests are executed and any errors reported. This is a basic reliability test.

D - Drive configuration. This option is used to specify the SCSI address and LUN of all attached drives. You can also load the address even if no drive is attached. This allows you to add drives later without running F.R.D. When this option is selected, the current drive configuration is displayed. The default value displayed is the current value.

You are then asked if you want to modify the configuration. If you answer "N", the control is returned to the Main Menu.

```
Number of drives to configure (1-7,def = 2 dec) :
Drive #1 i.d. (0-7,def = 1 dec) :
Drive #1 Lun number (0-7,def = 0 dec) :
Drive #2 i.d. (0-7,def = 0 dec) :
Drive #2 Lun number (0-7,def = 0 dec) :

Modify? (y/n,def = n) :
```

Figure 5-3. Drive Configuration Menu

A SCSI address and SCSI LUN must be defined for every drive in the system. Two values are written for each physical drive: the first value is the SCSI address of the controller and the second value is the drive's SCSI LUN. The value that you select in NOVRAM for each controller's SCSI address must match the corresponding SCSI address selected on the controller. Similarly, the value that you select in NOVRAM for each drive's LUN must match the corresponding LUN value selected on the drive. In addition, no two SCSI devices on any one SCSI bus can have the same SCSI address.

The SCSI controller address range is 0 through 7; the SCSI LUN range is 0 through 7. For each physical unit that you configure, you will be prompted to specify a value for both the SCSI controller address and for the drive LUN.

N - NOVRAM maintenance. Current configuration values are displayed and any errors are reported. You can make changes to the NOVRAM through this option.

T - Test selection menu. This option lets you selectively run any of the six onboard diagnostic tests. A loop count selection lets you determine how many times the tests are run.

S - Display switch settings. The switchpack ON/OFF settings are portrayed on this screen to verify that the firmware has interpreted your settings correctly. The specific configuration options represented by the switch settings are also identified.

5.4.2.1 All Tests

This option performs the following tests, in sequence: BOT and rewind test, write/read test, filemark test, space forward/reverse test, positioning test, and host memory DMA test.

Your response to the loop count prompt determines the number of passes of the test loop. A value of 0 causes the test sequence to continue until halted with a <ctrl/c>.

5.4.2.2 NOVRAM Maintenance

This function lets you specify the UC17/18's configuration options. When selected, the NOVRAM's current data is displayed on the terminal. You will see the NOVRAM parameter descriptor, followed by the range of values in parentheses.

The NOVRAM menu for the TMSCP emulation is shown in Figure 5-2.

NOTE

> The default value, which appears with the range of values for each option, is indeterminate and indicates only the current value. This value might or might not be the value that your installation requires.

If the NOVRAM maintenance function fails, it could be because of corrupted or unprogrammed NOVRAM. In this case, an error message will be printed and you are permitted to continue the operation.

You will then be asked if you want to modify the NOVRAM.

If you answer "N", control is returned to the Main Menu.

```
      Enable SCSI disconnect (y/n, def = y) :
      Usec delay between DMA bursts (2/4, def = 4) :
      Adaptive DMA (y/n, def = y) :
      Enable SCSI slow cable mode (y/n, def = n) :
      Enable SCSI parity checking (y/n, def = n) :
      Enable synchronous SCSI transfer mode (y/n, def = y) :
      Adaptive DMA threshold (1-7, def = 1 dec) :
      Max retry count for tape errors (0-10, def = 0 dec) :
      SCSI adapter i.d. (0-7, def = 7 dec) :

Modify?  (y/n, def = n) :
```

Figure 5-4. Sample TMSCP NOVRAM Maintenance Menu

If you answer "Y", the cursor moves to the first data field to be modified and you can make changes.

At a hardcopy terminal, the descriptors will be output and the cursor will be positioned at the end of the prompt.

If you enter a CTRL/Z or CTRL/C, control returns to the main menu and the NOVRAM will not be written.

Menu selections are described below.

Options:

- **Enable SCSI disconnect.** This parameter disables or enables SCSI disconnects. When enabled, drives performing time-consuming tasks release the SCSI bus temporarily and reconnect when the task is complete; thus, several operations can be performed at once. Timing considerations of unique software applications might dictate that you disable disconnects.

  A "Y" response enables SCSI disconnects, while a "N" response disables SCSI disconnects.

- **Usec delay between DMA bursts.** This parameter sets the value of time in microseconds that the UC17/18 waits to raise NPR (Non-Processor Request) between DMA bursts. The valid values are either 2 or 4.

- **Adaptive DMA.** This parameter enables or disables the UC17/18's adaptive DMA mode. Enabling this option ensures that CPU or other device functions are not locked out for excessive periods of time, by allowing the UC17/18, while in the middle of a DMA transfer, to release the bus to another device. When disabled, the UC17/18 will seize the bus for the entire DMA burst count.

  A "Y" response enables adaptive DMA, while a "N" response disables the mode.

- **Enable SCSI slow cable mode.** This parameter enables or disables the ESP IC's slow cable feature. A "Y" response enables the Slow Cable mode, while a "N" response disables the mode.

  This feature might need to be enabled in systems where unshielded cables of maximum SCSI bus length are used in noisy environments. The Emulex SCSI Processor (ESP) IC used on the UC17/18 is a very high speed device. Because of this speed, it is possible for the IC to react to a short duration noise pulse, which might be ignored by slower or lower performance SCSI chips. When the Slow Cable mode is enabled, the ESP chip requires longer signal durations on these critical signals, thereby acting as a noise filter. Emulex recommends using shielded SCSI cables and minimizing cable lengths, to eliminate the need for Slow Cable mode.

  If you must use unshielded maximum length cables, we recommend that you enable Slow Cable mode. Except in the case of very high speed synchronous disk drives, this use of Slow Cable mode will have no adverse effect on system performance.

- **Enable SCSI parity checking.** This parameter enables or disables SCSI parity checking. A "Y" response enables parity checking, while a "N" response disables parity checking. Before enabling this option, ensure that the SCSI device you are connecting supports parity.

- **Enable synchronous SCSI transfer mode.** This parameter enables or disables synchronous SCSI Transfer mode. A "Y" response enables synchronous SCSI data transfers; a "N" response disables the mode. Make sure the target device being configured supports synchronous transfers before enabling this mode.

- **Adaptive DMA threshold.** This parameter sets the DMA threshold value. The UC17/18 uses this value to determine how many words into a DMA burst it will wait before checking to see if another device on the UNIBUS bus has set NPR. The range is 1 through 7.

  The higher you set this value, the less often the UC17/18 will relinquish bus mastership to other devices. In VAX systems with a large number of interactive terminal users, the frequency of bus interrupts can be quite high. In this type of application, if you set the DMA threshold too low, the effect is to increase the length of time it takes for tape applications to complete. If you set the DMA threshold too high, it might affect the apparent user terminal response time. Emulex recommends setting this value over decreasing it only if terminal response or data late problems on other devices occur.

- **Max retry count for tape errors.** This parameter defines the number of retry operations that the controller will try before reporting an error. This is not a software parameter and will not affect software retries. Lowering the retry count will reduce the time required to initialize a tape, especially for tri-density drives. The range is 0 through 10. For an Exabyte drive, we recommend a value of 0, since this device does its own retries.

- **SCSI adapter i.d.** This parameter sets the SCSI address of the UC17/18 host adapter. The valid range is from 0 through 7.

5.4.2.3 Test Selection

This option permits you to selectively run any of the six tests by means of a menu. Type the letter of the test, followed by a <return>, at the prompt. Repeat for as many tests as you want, then select "Go" to begin test execution.

```
                    TEST SELECTION MENU

   B - BOT and Rewind
   W - Write/Read
   F - File mark
   S - Space forward/reverse
   P - Positioning
   E - Positioning to EOT
   R - Request Sense
   H - Host Memory DMA
   L - Loop Count
   D - Display selections
   C - Clear selections
   G - Go
   X - Exit this Menu


                 Select Function (def = X):


CTRL/C - Returns you to the previous level
CTRL/U - Deletes current input if no <CR> entered
```

Figure 5-5. Sample Tape F.R.D. Test Selection Menu

Six diagnostic tests and their descriptions follow. Other selections deal with displaying and running the tests.

B - **BOT and Rewind.** The UC17/18 checks for the Beginning of Tape (BOT) status by issuing a write, then a rewind, command.

W - **Write/Read.** The UC17/18 issues a series of write and read commands and compares the data.

F - **Filemark.** The UC17/18 writes a filemark, rewinds, spaces forward a record, and checks for the End of File (EOF).

S - **Space forward/reverse.** In this test, the UC17/18 issues commands to check that the tape drive is properly spacing forward and backward with respect to the EOF mark.

P - **Positioning.** The UC17/18 issues write, rewind, and space commands to check that the tape drive can position properly.

E - **Positioning to EOT.** The UC17/18 issues write, rewind, and space commands from BOT to EOT. On a full-length tape, this test could run for over two hours. You can shorten this time by using special low-capacity tape cartridges available from Exabyte.

R - **Request Sense.** This option causes the information returned by the SCSI request sense command to be displayed.

H - **Host Memory DMA.** The UC17/18 uses host memory as a scratch pad to verify that the UNIBUS bus function is transferring data properly.

L - **Loop Count.** This option lets you determine how many times, from 0 to 255, a given test is executed. Selecting 0 is equivalent to selecting an infinite number of passes. If this option is not used, the default number of executions is 1.

D - **Display selections.** This is a convenience option. Test selection is typically made by selecting (but not executing) the tests you want all at once, then selecting the "Go" option which executes the tests. If you want to see the tests you have selected prior to executing them, **Display selections** will list them on the screen. You can then either go ahead with test execution or change the tests.

C - **Clear selections.** If you want to cancel the tests you have previously selected but not executed, this option will effectively cancel all selections.

G - **Go.** This option begins test execution. You will be asked for confirmation that you do want to run the tests.

X - **Exit this Menu.** This option will return you to the Main Menu.

Completed tests are followed by a message on the screen confirming the number of passes made and the number, if any, of hard, soft, or device errors.

5.4.2.4 Display Switch Settings

This option shows the switch settings of SW1 and SW4 when using TMSCP on SCSI Port 0 or SW2 and SW3 when using TMSCP on SCSI Port 1. A sample display for SW1 (SW2 for Port 2) follows in Figure 5-6; a sample display for SW4 (SW3 for Port 2) is shown in Figure 5-7.

```
 Switch 1/2
OFF    ON
 -------
|       |
| [*  ] |    1    UC17/18 Host Adapter Reset Switch, Unreadable Hardware Switch
| [*  ] |    2    Enable Fast File Search
| [*  ] |    3    Not Used
| [*  ] |    4    Continue on self test error
|       |
 -------
```

Figure 5-6. Sample SW1 or SW2 Switch Setting Display

```
 Switch 3/4
OFF    ON
 -------
|       |
| [*  ] |    1    \
| [*  ] |    2    Address = 17774500 Oct
| [*  ] |    3    /
| [*  ] |    4    /
| [*  ] |    5    TMSCP
| [   ] |    6    Unreadable hardware switch
| [*  ] |    7    Not Used
| [*  ] |    8    Not Used
| [*  ] |    9    Not Used
| [*  ] |    10   Not Used
|       |
 -------
```

Figure 5-7. Sample SW3 or SW4 Switch Setting Display

5.5 Integration and Operation

5.5.1 Testing and Indicators

There are three light emitting diodes (LEDs) on the UC17/18 PWB. These LEDs are used for both diagnostics and for normal operations.

If switch SW1-1 is OFF, the UC17/18 executes a preliminary test at the following times:

- On power-up
- After a reset condition
- After a bus initialization
- After a write operation to the base address register

The self-test routine consists of two test sequences: preliminary and self-test. The preliminary test sequence exercises the 80C31 microprocessor chip and the Emulex SCSI Processor (ESP) chip. When the UC17/18 successfully completes the preliminary test, LED3 illuminates indicating that the UC17/18 is waiting for MSCP or TMSCP initialization.

During MSCP or TMSCP initialization, by host software control, the UC17/18 executes a second self-test that exercises the buffer controller chip, the Host Adapter Controller (HAC) chip and its associated circuitry, the onboard RAM, and the control memory EPROM. If the UC17/18 passes this sequence of its self-test successfully, all three UC17/18 LED indicators are OFF.

If a fatal error is detected either during self-test or while the system is running, all three of the LED indicators are ON (illuminated). If the UC17/18 fails to pass its power-up self-tests, you can select a special diagnostic mode (switch SW1-4 or SW2-4 ON) which causes the LED indicators to display an error code. See Fault Isolation Procedure in Section 6, TROUBLESHOOTING.

During normal operation, LED1 and LED2 flicker occasionally. These LEDs are used to indicate UNIBUS bus activity and SCSI activity, respectively.

5.5.2 Operation

There are no operational instructions. The UC17/18 is ready for MSCP or TMSCP initialization as soon as it is powered up.

Section 6
TROUBLESHOOTING

6.1 Overview

This section describes the several diagnostic features with which the UC17/18 Host Adapter is equipped, and outlines fault isolation procedures that use these diagnostic features.

Subsection	Title
6.1	Overview
6.2	Service
6.3	Fault Isolation Procedure
6.4	Power-Up Self-Diagnostic
6.5	Fatal Error Codes

6.2 Service

Your Emulex UC17/18 Host Adapter has been designed to give years of trouble-free service, and was thoroughly tested before leaving the factory.

Should one of the fault isolation procedures indicate that the UC17/18 is not working properly, the product must be returned to the factory or to one of Emulex's authorized repair centers for service. Emulex products are not designed to be repaired in the field.

Before returning the product to Emulex, whether the product is under warranty or not, you must contact the factory or the factory's representative for instructions and a Return Materials Authorization (RMA) number.

Do not return a product to EMULEX without authorization. A product or component returned for service without an authorization will be returned to the owner at the owner's expense.

In the continental United States, Alaska, and Hawaii contact:

Emulex Technical Support
3545 Harbor Boulevard
Costa Mesa, CA 92626
(714)662-5600 TWX (910) 595-2521
Outside California: (800) 854-7112

After 5 p.m. Pacific Time, call (800) 638-7243. When answered, you will be prompted to key in 37115, followed by a # symbol, then a message.

Outside the United States, contact the distributor from whom the subsystem was initially purchased.

To help you efficiently, Emulex or its representative requires certain information about the product and the environment in which it is installed. During installation, you should have made a record of the switch settings on the Configuration Reference Sheet.

After you have contacted Emulex and received an RMA, package the product (preferably using the original packing material) and send it **postage paid** to the address provided by the Emulex representative. You must also insure the package.

6.3 Fault Isolation Procedure

This fault isolation procedure is provided in flowchart form in Figure 6-1. This procedure is based on standard troubleshooting techniques as well as the self-diagnostics incorporated into the UC17/18. The procedure is designed to be used if the self-test fails or if many errors are flagged by the subsystem during normal operation. (If neither of these events takes place, then it is not necessary to follow these procedures.)

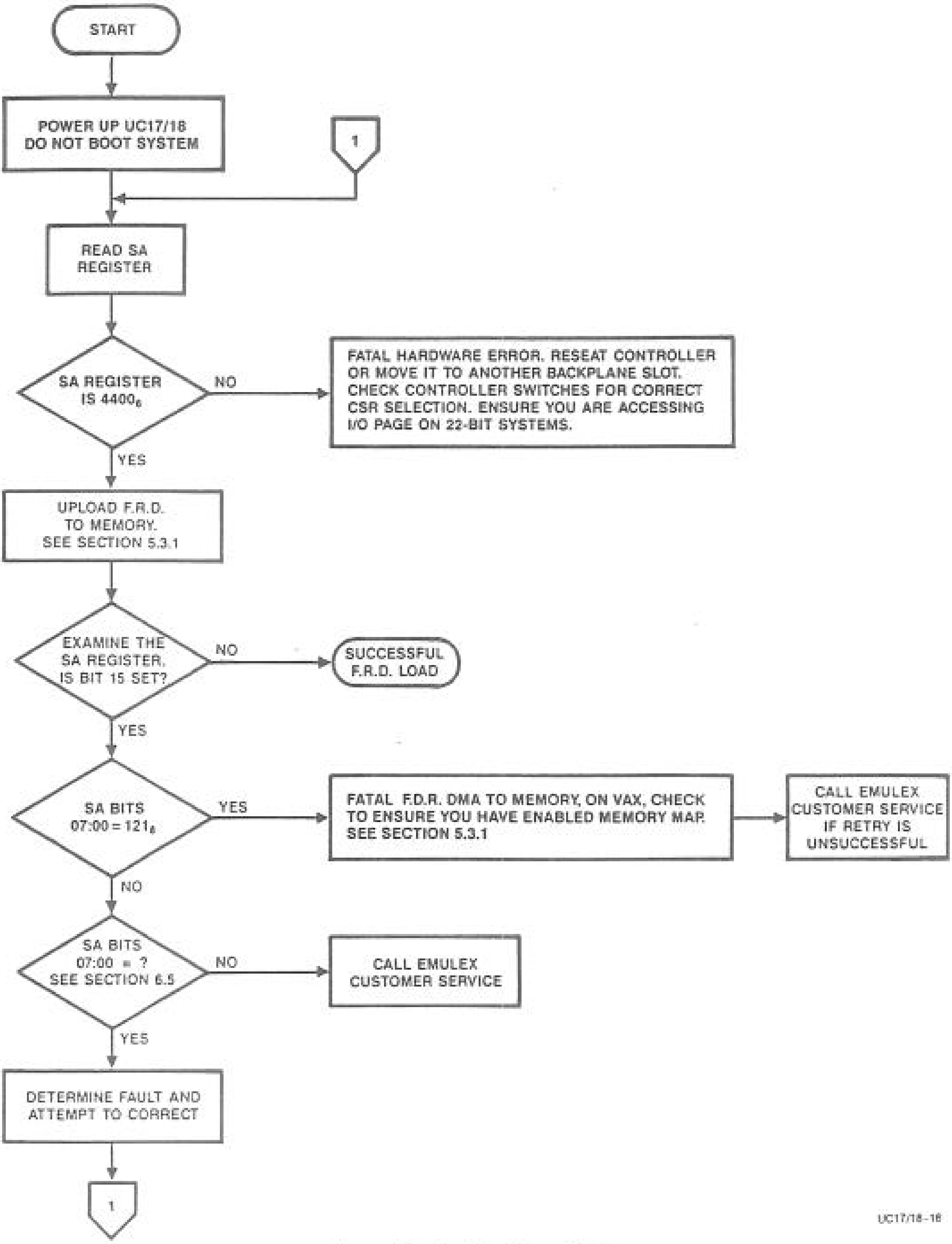


Figure 6-1. Fault Isolation Chart

6.4 Power-Up Self-Diagnostic

The UC17/18 executes an extensive self-diagnostic to ensure that the host adapter is in good working order. The self-test is divided into several parts. Table 6-1 indicates the order in which the tests are performed.

The first two tests are executed immediately after power-up, a reset, a bus INIT, or a write to the base address register. The other tests are executed as the controller interacts with the MSCP or TMSCP initialization routine. If the UC17/18 fails any of the tests, it posts a fatal error code in the low byte of the SA register (base address plus 2) and turns on all three LEDs. The MSCP and TMSCP fatal error codes used by the UC17/18 are listed in Table 6-2.

To help determine the location of the problem, the operator can select a special diagnostic mode that causes the LEDs to display an error code. To enable this diagnostic mode, halt the CPU. Turn ON SW1-4 (UC17/UC18 Port 1) or SW2-4 (UC17/UC18 Port 2). Next, the host computer must be powered down or the UC17/18 Reset/Halt switch (SW1-1 for UC17/18 Port 1; SW2-1 for Port 2) must be toggled (turned ON and then OFF) to cause the UC17/18 to again perform its self-test.

Upon encountering an error, the host microprocessor halts and the LEDs display an error code. The error codes are listed and described in Table 6-1.

If the UC17/18 completes the diagnostic mode without errors, all three LEDs are OFF. After testing is complete, be sure to turn OFF SW1-4 or SW2-4. Reset the UC17/18 Host Adapter before using it.

Table 6-1. LED Error Codes

LED 3	 2	 1	Error Description
0	0	1	CPU Chip Test failed
0	1	0	SCSI Chip Test failed
1	0	0	Controller idle, waiting for initialization
0	1	1	Buffer Controller or External Memory Test failed
1	0	1	HAC Test failed
1	1	0	Emulation EPROM Checksum Test failed
0	0	0	Self-diagnostic complete without errors
1	1	1	Refer to Table 6-2

NOTE

The UC17/18 might fail the power-up self-diagnostic if the SCSI target device that supplies terminator power to the SCSI bus is powered off. Proper operation of the SCSI bus requires that terminator power be present at all times.

6.5 Fatal Error Codes

If the UC17/18 encounters a fatal error anytime during operation, all three LEDs are illuminated and an error code is posted in the low byte of the SA register (base address plus 2). Table 6-2 lists the MSCP and TMSCP fatal error codes used by the UC17/18.

Table 6-2. MSCP and TMSCP Fatal Error Codes used by the UC17/18

Octal Code	Hex Code	Description
0	0	No information in message packet.
1	1	Possible parity or timeout error when the UC17/18 attempted to read data from a message packet.
2	2	Possible parity or timeout error when the UC17/18 attempted to write data to a message packet.
4	4	UC17/18 diagnostic self-test indicated a controller RAM error.
5	5	UC17/18 diagnostic self-test indicated a firmware checksum error.
6	6	Possible parity or timeout error when the UC17/18 attempted to read an envelope address from a command ring.
7	7	Possible parity or timeout error when the UC17/18 attempted to write an envelope address to a command ring.
11	9	Host did not communicate with UC17/18 within the time frame established while bringing the controller online.
12	A	Operating system sent more commands to the UC17/18 than the controller can accept.
13	B	UC17/18 unable to perform DMA transfer operation correctly.
14	C	UC17/18 diagnostic self-test indicated controller fatal error.
16	E	The MSCP or TMSCP connection identifier is invalid.
23	13	An error occurred during the MSCP or TMSCP initialization sequence.

Additional fatal error messages might appear. These error codes are listed in Table 6-3.

Table 6-3. Fatal Error Codes

Octal Code	Hex Code	Description
004	04	RAM error
005	05	Firmware checksum error
014	0C	Fatal error during self-test
111	49	Autoboot timeout
121	51	F.R.D. load to memory failed

Section 7
MSCP/TMSCP COMPATIBILITY AND ODT PROGRAMMING

7.1 Overview

This section contains an overview of the UC17/18 device registers that are accessible to the UNIBUS and are used to monitor and control the UC17/18 Host Adapter. The registers are functionally compatible with DEC implementations of MSCP controllers.

The following table outlines the contents of this section.

Subsection	Title
7.1	Overview
7.2	Overview of MSCP Subsystem
7.3	MSCP and TMSCP Command Compatibility
7.4	Registers
7.5	Bootstrap Command (Disk Only)

7.2 Overview of MSCP Subsystem

Mass Storage Control Protocol (MSCP) is the protocol used by a family of mass storage controllers and devices designed and built by Digital Equipment Corporation. MSCP allows a host system to be connected to subsystems with a variety of capacities and geometries. This flexibility is possible because MSCP defines data locations in terms of sequential, logical blocks, not in terms of a physical description of the data's location (i.e., cylinder, track, and sector). This scheme gives the MSCP subsystem the responsibility for converting MSCP logical block numbers into physical addresses that the peripheral device can understand.

This technique has several implications. First, the MSCP subsystem must have detailed knowledge of the peripheral's capacity, geometry, and status. Second, the ability to make the translation between logical and physical addresses implies considerable intelligence on the part of the subsystem. Finally, the host is relieved of responsibility for error detection and correction because its knowledge of the media is insufficient to allow error control to be done efficiently.

There are several advantages to this type of architecture. First, it provides the host with an "error-free" media. Second, it provides for exceptional operating system software portability because, with the exception of capacity, the characteristics of all MSCP subsystems are the same from the operating system's point of view.

In terms of implementation, this protocol requires a high degree of intelligence on the part of the subsystem. Essentially, this intelligence is a process that runs on a microprocessor and is referred to as an MSCP controller. The MSCP controller has all of the responsibilities outlined above.

The host computer runs corresponding software processes that take calls from the operating system, convert them into MSCP commands, and cause the resulting command to be transferred to the MSCP controller.

In summary, an MSCP subsystem is characterized by an intelligent controller that provides the host with the view of a perfect media. It is further characterized by host independence from a specific bus, controller, or device type.

7.3 MSCP and TMSCP Command Compatibility

A complete description of MSCP commands and the corresponding status responses which the UC17/18 Host Adapter posts is beyond the scope of this manual.

7.3.1 Command Support

No currently available MSCP Controller supports the entire range of MSCP commands. The following subsections describe the extent of MSCP command support by the UC17/18.

7.3.1.1 Minimal Disk or Tape Subset

The UC17/18 Host Adapter supports the entire minimal disk subset of MSCP commands, and the entire minimal tape subset of TMSCP commands.

7.3.1.2 Diagnostic and Utility Protocol (DUP)

The UC17/18 Host Adapter does not support any of the DUP commands or maintenance read/write commands. Therefore, the UC17/18 is not compatible with DEC diagnostics that use the MSCP or TMSCP DUP commands.

7.4 Registers

During normal operation, the UC17/18 Host Adapter is controlled and monitored using the command and status packets that are exchanged by the Class Driver (host) and the MSCP Controller. The UC17/18 has two 16-bit registers in the I/O page that are used primarily to initialize the subsystem. During normal operation, the registers are used only to initiate polling or to reset the subsystem. These registers are always read as words.

The IP register (base address) has two functions as detailed below:

- When written with any value, it causes a hard initialization of the MSCP Controller.
- When read while the port is operating, it causes the controller to initiate polling.

The SA register (base address plus 2) has three functions as listed below:

- When read by the host during initialization, it communicates data and error information relating to the initialization process.
- When written by the host during initialization, it communicates certain host-specific parameters to the port.
- When read by the host during normal operation, it communicates status information including port and controller-detected fatal errors.

7.5 Bootstrap Command (Disk Only) on a PDP-11

To allow the system to be easily bootstrapped from peripherals attached to the UC17/18 Host Adapter, Emulex has incorporated a Bootstrap Command into the controller. This feature is not part of the standard MSCP command set; it is supported on 1124-type processors. Autoboot is not supported on 1134, 1144, 1170, 1184, or VAX UNIBUS.

The Bootstrap Command can be issued from the console after the system is powered up, or it can be incorporated into a firmware routine that is located in a Bootstrap ROM. (The ROM would not be located on the UC17/18 PWB, but on some other module in the system.) The Bootstrap Command causes the UC17/18 to load the first logical block from the selected peripheral into host memory starting at location 00000.

To issue the Bootstrap Command to the UC17/18, at the console emulator prompt, enter the following sequence (operator input is displayed in **boldface**; all numbers are in octal):

```
@7xxxxx/00000<lf>                  <lf> = LINE FEED
7yyyyy/004400₈ 30003<cr>           <cf> = CARRIAGE RETURN
@/000400 40000<cr>
@RS/456332  304<cr>
@R0/103741  0<lf>                  Logical unit number to boot from
R1/001276  77xxxx<cr>              Or appropriate address from Table 7-1.
@0G
```

NOTE: XXXXX and YYYYY are offsets dependent on the address of the UC17/18 controller. See Table 7-1 for the appropriate values.

Table 7-1. UNIBUS Offsets for MSCP Emulations

UC17/18 Bus Address (Octal)	XXXX (Octal)	YYYYY (Octal)
17772150	72150	72152
17772154	72154	72156
17760334	60334	60336
17760340	60340	60342
17760344	60344	60346
17760350	60350	60352
17760354	60354	60356
17760360	60360	60362
17760364	60364	60366
17760370	60370	60372
17760374	60374	60376
17760400	60400	60402
17760404	60404	60406
17760410	60410	60412
17760414	60414	60416
17760420	60420	60422

Section 8
FUNCTIONAL DESCRIPTION

8.1 Overview

This section contains a description of the UC17/18 Host Adapter's architecture.

8.2 UC17 and UC18 Host Adapter Architecture

The UC17 and UC18 are microprocessor-based host adapters, each of which is contained on a single quad-wide PCBA. The UC17 is a single-function host adapter, while the UC18 is a dual-function host adapter that is essentially two UC17s contained on a single PCBA. The remainder of this section describes the architecture of only the UC17; the architecture of each part of the dual-function UC18 is similar. The UC17's major functional blocks are shown in Figure 8-1.

The UC17 Host Adapter is organized around the eight-bit 80C31 microprocessor. The board has an eight-bit internal data bus with 16-bit addressing capability. The 80C31 addresses the Buffer Controller, the Host Adapter Controller (HAC), and the Emulex SCSI Processor (ESP) as memory (memory-mapped I/O).

The 80C31's primary task is to decode and implement commands from the host. At command completion, the microprocessor is also responsible for generating status and transmitting it to the host. A large part of the microprocessor's job while performing those duties involves setting up the HAC and the Buffer Controller for the large data transfers, which are their specialties.

The UC17 uses a 64K Byte erasable programmable read-only memory (EPROM), which contains the firmware (control program). Also, the UC17 has 64K bytes of random access memory (RAM), which is used for data buffering and working storage.

The UNIBUS bus interface contains 57 lines. Sixteen of the lines are used for address, sixteen for data; six are used for address only. The HAC is used for programmed I/O, CPU interrupts, and DMA data transfers. The microprocessor responds to all programmed I/O and carries out the I/O functions required for the addressed host adapter register. The HAC has automatic UNIBUS bus address generation capability that, in conjunction with a byte counter, allows the interface to conduct UNIBUS bus DMA transfers without direct microprocessor intervention after the interface is set up for a transfer. This automatic DMA capability is used with the UC17 Buffer Controller to transfer large blocks of data directly between host memory and the UC17's RAM.

The SCSI interface and control is implemented using a single VLSI chip, the ESP. In response to commands from the microprocessor, the chip establishes and monitors SCSI bus phases appropriate to the command and thus relieves the microprocessor of signal control and timing duties.

The Buffer Controller is implemented on a single chip. This four-channel controller is responsible for moving large blocks of data between the 64K RAM buffer and the SCSI interface, and between the UNIBUS bus interface and the 64K RAM buffer. After being set up for an operation by the microprocessor, either interface requests DMA service from the Buffer Controller logic by driving an individual request signal active. The transfer then proceeds without direct intervention by the microprocessor. This allows high-speed data transfers to occur while the microprocessor is focused on other processes.

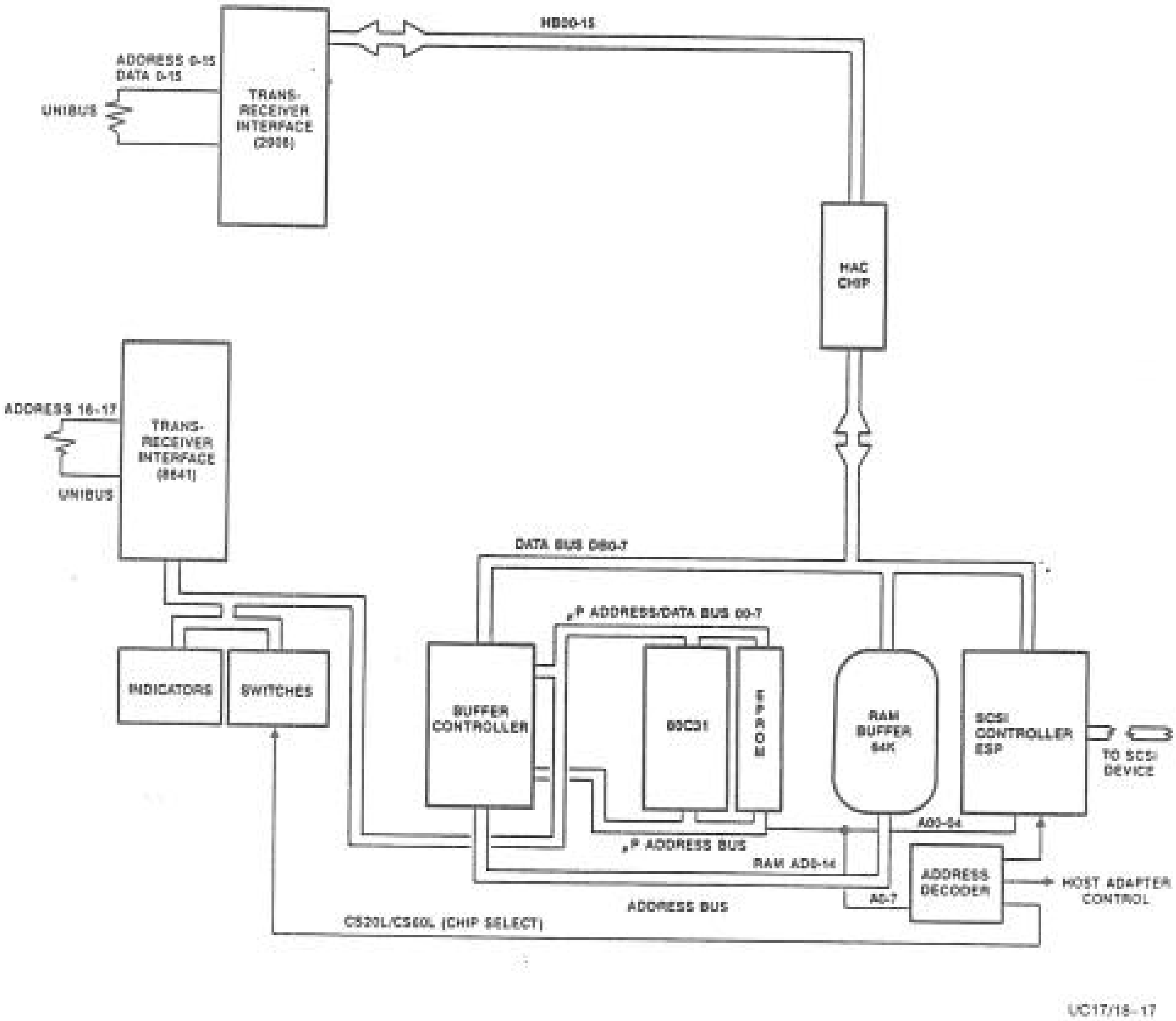


Figure 8-1. UC17 Block Diagram

Section 9
INTERFACES

9.1 Overview

This section describes the interfaces that the host adapter incorporates. It includes information on the host adapter's implementation of SCSI bus specification electrical and mechanical requirements. Including this overview, the section is divided into the following subsections.

Subsection	Title
9.1	Overview
9.2	Host Adapter to UNIBUS Interface
9.3	Host Adapter to SCSI Bus Interface

9.2 Host Adapter to UNIBUS Interface

The UNIBUS between the CPU and the UC17/18 Disk Controller contains 18 address lines and 16 bidirectional data lines, plus control signals for data and interrupt vector address transfer and for becoming bus master. UNIBUS interface pin assignments are listed and described in Table 9-1. These signal lines provide the means by which the CPU and the UC17/18 Disk Controller communicate with each other.

Table 9-1. UNIBUS Interface Pin Assignments

Connector C			Connector D		
Component Side 1	**Pin**	**Solder Side 2**	**Component Side 1**	**Pin**	**Solder Side 2**
NPGIN H	A	+5V		A	+5V
NPG H	B			B	
PA L	C	GND		C	GND
	D	D15 H		D	
	E	D14 H		E	
BRN TST H	F	D13 H		F	BR5 L
D11 H	H	D12 H		H	
	J	D10 H		J	
	K	D09 H		K	BG7 H
	L	D08 H	INIT L	L	BG7 H
	M	D07 H		M	BG6 H
DCLO L	N	D04 H		N	BG6 H
	P	D05 H		P	BG5IN H
	R	D01 H		R	BG5 H
PB L	S	D00 H		S	BG4 H
GND	T	D03 H	GND	T	BG4 H
	U	D02 H		U	
ACLO L	V	D06 H		V	
Connector E			**Connector F**		
Component Side 1	**Pin**	**Solder Side 2**	**Component Side 1**	**Pin**	**Solder Side 2**
	A	+5V		A	+5V
	B			B	
UA12 H	C	GND		C	GND
A17 L	D	UA15 H	BBSY L	D	
MSYN L	E	A16 L		E	
UA02 H	F	C1 L		F	
UA01 H	H	UA00 H		H	
SSYN L	J	C0 L	NPR L	J	
UA14 H	K	UA13 H		K	
UA11 H	L			L	
	M		INTR L	M	
	N	UA08 H		N	
UA10 H	P	UA07 H		P	
UA09 H	R			R	
	S			S	
GND	T		GND	T	SACK L
UA06 H	U	UA04 H		U	
UA05 H	V	UA03 H		V	

9.2.1 Interrupt Priority Level

The UC17/18 is hard wired to issue level 5 interrupt requests.

9.2.2 Register Address

The host adapter has two registers visible to the UNIBUS. Their addresses are determined by DIP switches. See Section 4 for detailed address and switch setting information.

9.2.3 DMA Operations

All DMA data transfer operations are performed under microprocessor control. When doing a Read From Memory operation, a check is made for memory parity or nonexistent memory (NXM) errors; during a Write operation a check is made for NXM errors. If an error is detected, an MSCP status error is returned.

9.3 Host Adapter to SCSI Bus Interface

This subsection provides information on the host adapter's implementation of SCSI bus electrical and mechanical requirements.

9.3.1 SCSI Interface Physical Description

SCSI bus devices are daisy-chained together using a common cable. Both ends of the cable are terminated. All signals are common between all bus devices. The host adapter supports the SCSI specification single-ended option for drivers and receivers. The maximum cable length allowed is 20 feet (six meters). This cabling is primarily for interconnection outside the subsystem cabinet in which the host adapter resides.

9.3.1.1 Cable Requirements

A 50-conductor flat cable or 25-twisted-pair flat cable must be used to connect SCSI bus hosts and controllers. The maximum cable length is 20 feet (six meters). The maximum length of the cable past the terminator is 0.1 meter. SCSI bus termination can be internal to the SCSI devices that are located at the ends of the bus cable (such as the subsystem that contains the SCSI device controller and its peripheral). The host adapter single-ended pin assignments are shown in Table 9-1.

9.3.1.2 Shielded Connector Requirement

The SCSI bus shielded connector is a 50-conductor cable connector that consists of two rows of 25 female contacts on 100 mil centers. The connector shielding system must provide a DC resistance of less than 10 milliohms from the cable shield at its termination point to the SCSI device enclosure.

9.3.2 SCSI Interface Electrical Description

The host adapter interfaces to SCSI controllers via the SCSI bus. A 50-pin male IDC connector at location J1 on the UC17 board (J1 and J2 on the UC18 board) plugs directly into the SCSI bus (refer to Figure 4-3). All signals use open collector or three-state drivers. Each signal driven by a SCSI device has the following output characteristics when measured at the SCSI device's connection:

- Signal assertion = 0.0 Vdc to 0.4 Vdc
- Minimum driver output capability = 48 milliamperes (sinking) at 0.5 Vdc
- Signal negation = 2.5 Vdc to 5.25 Vdc

All assigned signals are terminated with 220 ohms to termination power and 330 ohms to ground at each end of the SCSI cable as shown in Figure 9-2. Refer to Appendix D for further details concerning termination power.

Each signal received by a SCSI device has the following input characteristics when measured at the SCSI device's connection:

- Signal true = 0.0 Vdc to 0.8 Vdc
- Maximum total input load = -0.4 milliamperes at 0.4 Vdc
- Signal false = 2.0 Vdc to 5.25 Vdc
- Minimum input hysteresis = 0.2 Vdc

Table 9-2. UC17/18 SCSI Bus Pin Assignments

Pin	Signal Name	Input/Output
1	GND	---
2	-D0	Input/Output
3	GND	---
4	-D1	Input/Output
5	GND	---
6	-D2	Input/Output
7	GND	---
8	-D3	Input/Output
9	GND	---
10	-D4	Input/Output
11	GND	---
12	-D5	Input/Output
13	GND	---
14	-D6	Input/Output
15	GND	---
16	-D7	Input/Output
17	GND	---
18	-DP (Data parity)	Input/Output
19	GND	---
20	GND	---
21	GND	---
22	GND	---
23	GND	---
24	GND	---
25		Not connected
26	TERMPWR	Output
27	GND	---
28	GND	---
29	GND	---
30	GND	---
31	GND	---
32	-ATN	Input/Output
33	GND	---
34	GND	---
35	GND	---
36	-BSY	Input/Output
37	GND	---
38	-ACK	Input/Output
39	GND	---
40	-RST	Input/Output
41	GND	---
42	-MSG	Input/Output
43	GND	---
44	-SEL	Input/Output
45	GND	---
46	-C/D	Input/Output
47	GND	---
48	-REQ	Input/Output
49	GND	---
50	-INPUT/OUTPUT	Input/Output

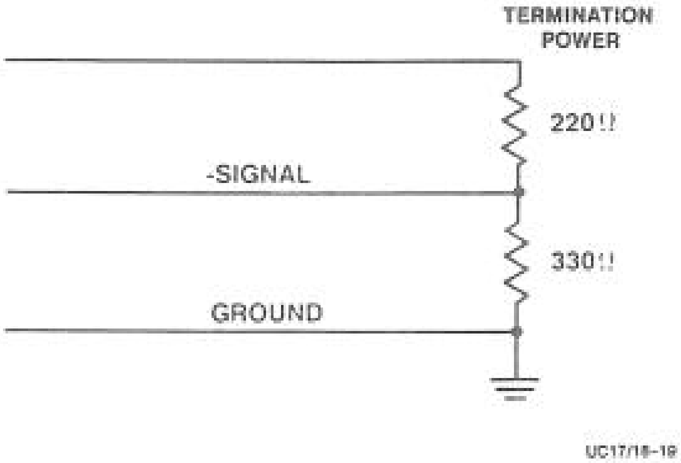


Figure 9-1. UC17/18 SCSI Bus Signals Termination

9.3.3 SCSI Bus Signals and Timing

SCSI bus activities involve one or more of the following SCSI phases of operation:

- Arbitration Phase
- Selection Phase
- Reselection Phase
- Command Phase
- Data Phase
- Status Phase
- Message Phase

The phases are described in subsection 10.3. When the SCSI bus is not involved in one of the above phases, it is in the Bus Free Phase. SCSI phase sequencing is accomplished by asserting or de-asserting the SCSI signals; the signals are described in subsection 10.3.3.1.

9.3.3.1 SCSI Bus Signals

There are 18 signals on the SCSI bus. Nine signals are control signals that coordinate transfer of data between SCSI hosts/ controllers; nine signals are for an eight-bit data bus with parity. The signals are defined in Table 9-2.

In Table 9-3, the eight data bit signals are represented by DB0 through DB7; DB7 is the most significant bit and has the highest priority during the Arbitration Phase. Bit number, significance, and priority decrease downward to DB0. The parity bit, represented by DBP, is odd. The host adapter generates parity which is selected through NOVRAM parameters. Parity is not guaranteed valid during the Arbitration Phase.

The host adapter's SCSI bus pin assignments are listed in Table 9-2; the host adapter supports only the SCSI single-ended option.

Table 9-3. SCSI Bus Signals

Mnemonic Name	Signal	Description
DB0	Data Bus	Data Bus Bit 0
DB1	Data Bus	Data Bus Bit 1
DB2	Data Bus	Data Bus Bit 2
DB3	Data Bus	Data Bus Bit 3
DB4	Data Bus	Data Bus Bit 4
DB5	Data Bus	Data Bus Bit 5
DB6	Data Bus	Data Bus Bit 6
DB7	Data Bus	Data Bus Bit 7
DBP	Data Bus	Data Bus Parity
ACK	Acknowledge	Indicates acknowledgement for a REQ/ACK data transfer handshake.
REQ	Request	Indicates a request for a REQ/ACK data transfer handshake.
ATN	Attention	Indicates the ATTENTION condition (i.e., the Initiator has a message to send to the Target). The ATTENTION condition is described in subsection 9.5.2.
RST	Reset	Indicates the RESET condition (i.e., clears the SCSI bus of all activity). The RESET condition is described in subsection 9.5.1.

(continued next page)

Table 9-3. SCSI Bus Signals (continued)

Mnemonic Name	Signal	Description
SEL	Select	Used to select/reselect a SCSI bus device.
BSY	Busy	Indicates the SCSI bus is being used.
C/D	Control/Data	Indicates command/status information transfer or data in/data out transfer.
I/O	Input/Output	Indicates the direction of data movement on the data bus with respect to an Initiator and is used during reselection.
MSG	Message	Indicates the SCSI bus is in the Message Phase.
TERMPWR	Termpwr	Provides jumper-selectable termination power to the terminator at the opposite end of the SCSI bus.

9.3.3.2 SCSI Bus Timing

Except where noted, the delay time measurements for each SCSI device (host or controller) are calculated from signal conditions existing at that device's SCSI bus connection. Normally, these measurements do not consider delays in the SCSI cable. The SCSI timings are listed in Table 9-3.

The timing diagram shown in Figure 9-3 indicates the typical relationship between SCSI bus signals and SCSI phase sequencing.

Table 9-4. SCSI Bus Timings

Timing	Duration	Description
Arbitration Delay	2.2 us	The minimum time a SCSI host or controller waits from asserting the BSY signal for arbitration until the data bus can be examined to see if arbitration has been won. There is no maximum time.
Bus Clear Delay*	800 ns	The maximum time for a SCSI host or controller to stop driving all bus signals after 1) a Bus Free Phase is detected, 2) the SEL signal is received from another SCSI host or controller during the Arbitration Phase.
Bus Free Delay	800 ns	The minimum time a SCSI host or controller waits from its detection of the Bus Free Phase until it asserts the BSY signal when going to the Arbitration Phase.
Bus Set Delay	1.8 us	The maximum time for a SCSI host or controller to assert the BSY signal and its SCSI ID bit on the data bus after it detects a Bus Free Phase for entering the Arbitration Phase.
Bus Settle Delay	400 ns	The time to wait for the SCSI bus to settle after changing certain control signals.
Cable Skew Delay	10 ns	The maximum difference in propagation time allowed between any two SCSI bus signals when measured between any two SCSI devices.
Deskew Delay	45 ns	This time is used to calculate the minimum time required for deskew of signals.
Reset Hold Time	25 us	The minimum time for which the RST signal is asserted. There is no maximum time.

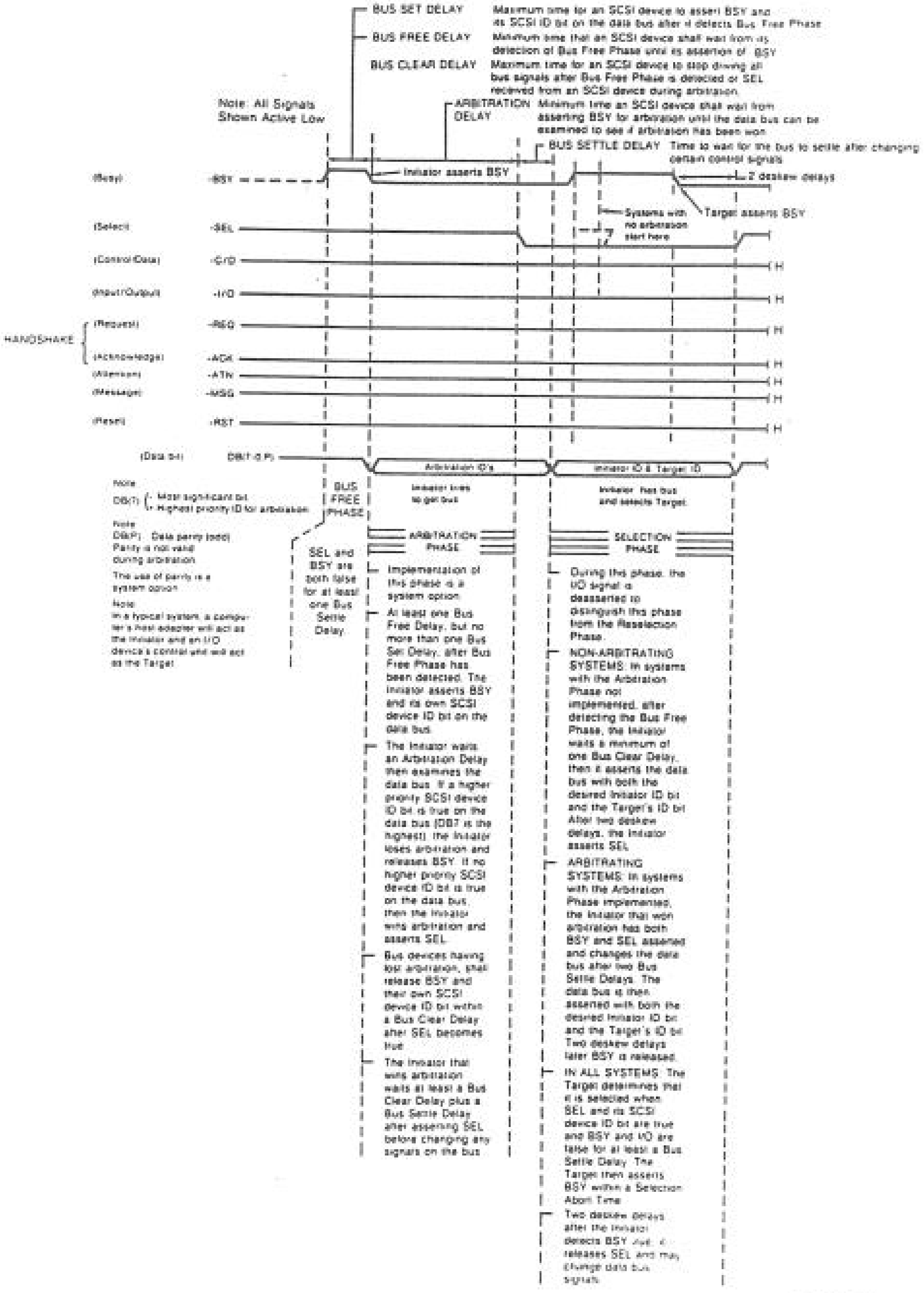
* In the Bus Clear Delay, for condition 1) the maximum time for a SCSI device to clear the bus is 1200 ns from the BSY and SEL signals both first becoming false. If a SCSI device requires more than a Bus Settle Delay to detect the Bus Free Phase, it clears the bus within a Bus Clear Delay minus the excess time.

(continued on next page)

Table 9-4. SCSI Bus Timings (continued)

Timing	Duration	Description
Selection Abort Time	200 us	The maximum time a Target (or Initiator) takes from its most recent detection of being selected (or reselected) until it asserts the BSY signal. This timeout is required to ensure that a Target (or Initiator) does not assert the BSY signal after a Selection (or Reselection) Phase has been aborted. This is not the Selection timeout.
Selection Timeout Delay	250 ms	The minimum recommended time that an Initiator (or Target) should wait for a BSY response during the Selection or Reselection Phase before starting the timeout procedure.

ms = milliseconds
us = microseconds
ns = nanoseconds



BUS SET DELAY Maximum time for an SCSI device to assert BSY and its SCSI ID bit on the data bus after it detects Bus Free Phase

BUS FREE DELAY Minimum time that an SCSI device shall wait from its detection of Bus Free Phase until its assertion of BSY

BUS CLEAR DELAY Maximum time for an SCSI device to stop driving all bus signals after Bus Free Phase is detected or SEL received from an SCSI device during arbitration.

ARBITRATION DELAY Minimum time an SCSI device shall wait from asserting BSY for arbitration until the data bus can be examined to see if arbitration has been won

BUS SETTLE DELAY Time to wait for the bus to settle after changing certain control signals

Note: All Signals Shown Active Low

Note

DB(7) – Most significant bit – Highest priority ID for arbitration

Note

DB(P) Data parity (odd) Parity is not valid during arbitration

The use of parity is a system option

Note

In a typical system, a computer's host adapter will act as the Initiator and an I/O device's control unit will act as the Target

SEL and BSY are both false for at least one Bus Settle Delay

ARBITRATION PHASE

- Implementation of this phase is a system option.
- At least one Bus Free Delay, but no more than one Bus Set Delay, after Bus Free Phase has been detected. The Initiator asserts BSY and its own SCSI device ID bit on the data bus.
- The Initiator waits an Arbitration Delay then examines the data bus. If a higher priority SCSI device ID bit is true on the data bus (DB7 is the highest), the Initiator loses arbitration and releases BSY. If no higher priority SCSI device ID bit is true on the data bus, then the Initiator wins arbitration and asserts SEL.
- Bus devices having lost arbitration, shall release BSY and their own SCSI device ID bit within a Bus Clear Delay after SEL becomes true.
- The Initiator that wins arbitration waits at least a Bus Clear Delay plus a Bus Settle Delay after asserting SEL before changing any signals on the bus

SELECTION PHASE

- During this phase, the I/O signal is deasserted to distinguish this phase from the Reselection Phase.
- NON-ARBITRATING SYSTEMS: In systems with the Arbitration Phase not implemented, after detecting the Bus Free Phase, the Initiator waits a minimum of one Bus Clear Delay, then it asserts the data bus with both the desired Initiator ID bit and the Target's ID bit. After two deskew delays, the Initiator asserts SEL.
- ARBITRATING SYSTEMS: In systems with the Arbitration Phase implemented, the Initiator that won arbitration has both BSY and SEL asserted and changes the data bus after two Bus Settle Delays. The data bus is then asserted with both the desired Initiator ID bit and the Target's ID bit. Two deskew delays later BSY is released.
- IN ALL SYSTEMS: The Target determines that it is selected when SEL and its SCSI device ID bit are true and BSY and I/O are false for at least a Bus Settle Delay. The Target then asserts BSY within a Selection Abort Time.
- Two deskew delays after the Initiator detects BSY true, it releases SEL and may change data bus signals.

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Figure 9-2. SCSI Bus Timing Diagram (Sheet 1 of 3)